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ABSTRACT

Reviewed are the highlights of the president's 1981 budget proposal as they pertain to research and development (R&D) funds. Examined are research and development funding trends; 1981 program changes; performers; and proposed budgets for NASA, DOE, HHS NSF, and USDA. (CO)

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SCIENCE RESOURCES STUDIES HIGHLIGHTS

NATIONAL SCIENCE FOUNDATION WASHINGTON, D.C. 20550 DECEMBER 31, 1980 NSF 80-322

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Federal R&D Obligations Will Show Real Growth In 1981—Mostly From DOD Programs

The following data are from the Federal Funds for Research and Development, Volume XXIX survey, conducted in the second quarter of fiscal year 1980, following the President's January budget message for 1981 and the subsequent March revision. The data are actual for 1979 but reflect estimates, including rescissions proposed by the administration for 1980, and requested amounts, including proposed budget amendments, for 1981. Later legislative and executive actions will change the amounts shown in the survey for 1980 and 1981. Such of these actions as have occurred by the end of October are noted in the text.

Highlights

- The President's 1981 budget, as revised in March 1980, included a request for R&D obligations (excluding R&D plant) totaling $35.5 billion, 11 percent more than the total shown for fiscal year 1980. Proposed funding for the Department of Defense (DOD) accounted for four-fifths of this increase.

- The March budget revisions reduced the amounts requested in the January budget document for both basic and applied research. These revisions effectively eliminated real growth after inflation in 1981, but plans for real growth in development obligations were retained.[1] In a statement released in August, however, the President pledged, as part of an economic revitalization program, "... additional funds ... to maintain real growth of 3 percent in basic research ..."

- Since 1975, R&D and R&D plant outlays have comprised some 13 percent to 14 percent of the relatively controllable portion of the Federal budget. Even after the March revision, the 1982 budget showed a 14-percent ratio of R&D and R&D plant outlays to controllable outlays—an increase of 1 percentage point over the 1980 ratio.

- The estimated *constant-dollar* value of the Federal R&D total in 1981 was only 10 percent higher than in 1971, despite R&D funding having more than doubled in current dollars in that period.

- In the March revision, some new programs scheduled for large increases in January were reduced. Among these were the automotive basic research program, administered by the Department of Transportation (DOT); the industrial innovation program under the National Science Foundation (NSF) and the Department of Commerce; and the NSF university research facilities program. Almost all the major support agencies showed lower relative overall R&D increases in the 1981 budget revision than increases proposed in January. DOD, by contrast, received a 20-percent increase, the same relative increase scheduled for this agency in the original budget.

- Increases in the March budget for DOD weapons programs accounted for most of the 12-percent increase reflected in the $22.6 billion request for Federal development funds for 1981. Projected work on the M-X strategic missile absorbed one-third of the DOD increase in development obligations.

- The March budget showed a decline in real terms in 1982 basic research obligations, following four successive years of real growth that averaged 5.3 percent annually. Subsequent congressional appropriation actions and administration announcements, however, indicated a basic research total sufficiently above the revised $4.9 billion level to provide some real growth in 1981.

- Applied research support, scheduled to rise 10 percent to $8.0 billion in 1981, would show only the same level of support in constant dollars as in 1980, despite a sharp increase in DOD funds. The small relative increases in applied research funds for the

[1] At the time this report was prepared, the estimate used by the Office of Management and Budget (OMB) for the fiscal year 1981 rate of inflation was 10.1 percent, based on the GNP implicit price deflator.

Prepared in the Government Studies Group, Division of Science Resources Studies

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Department of Health and Human Services (HHS) and the National Aeronautics and Space Administration (NASA) accounted for the fact that Federal applied research obligations were not expected to show real growth in 1981.

• The large DOD increase in the 1981 budget will noticeably affect Federal R&D totals in three performing sectors: The Federal intramural sector, up an estimated 11 percent; the industrial sector (including FFRDC's),[2] up an estimated 13 percent; and FFRDC's administered by nonprofit institutions, up an estimated 14 percent. By contrast, the university-and-college sector, chiefly supported by HHS, received only 8 percent more funds than in 1980, a real decline in Federal R&D support for the second consecutive year. The plan for increased basic research support, however, specifically aimed at university research, should counteract the real decline indicated in the budget.

Relationship to Total Federal Budget

The share of R&D and R&D plant outlays within the overall Federal budget was 5.7 percent in 1976 and has remained virtually the same since then. From 1965 to 1975, however, a steady decline took place in the ratio of the R&D portion of the budget to the total budget, as funds for non-R&D programs—especially social programs—increased at a faster rate than funds for research and development. The stability of the ratio in the years since 1975 can be largely ascribed to a resurgence of growth in Federal development programs related to energy, defense, and space undertakings that has produced growth in the Federal R&D total.

During the second half of the seventies, R&D and R&D plant outlays within the *relatively controllable* portion of the Federal budget also maintained a consistent share—between 13 percent and 14 percent. Relatively controllable outlays are subject to annual authorization and appropriation actions that require new decisions; this distinguishes them from relatively uncontrollable outlays where fixed costs and open-ended programs[3] under trust funds are largely mandated by existing statutues, although some appropriations are made for administrative and other program costs. The ratio of R&D outlays to outlays over which the Government has more immediate control is a more meaningful indicator of the relative priority placed on Federal R&D programs than the ratio of R&D to total Federal outlays. Between 1980 and 1981, a gain of almost 1 percentage point (to 14 percent) was realized, even after the budget revisions.

R&D Trends

In 1971 Federal R&D funding began to rise steadily, after several years of decline, with a marked upward trend starting in 1975. That year, and in subsequent years, growing inflation cancelled out most real R&D gains (chart 1). Between 1974 and 1980, the average annual rate of growth in constant dollars was only 2.2 percent. The estimated constant-dollar value of the Federal R&D total in 1981 was only 10 percent higher than in 1971, despite a more than doubling in current-dollar funding (table 1).

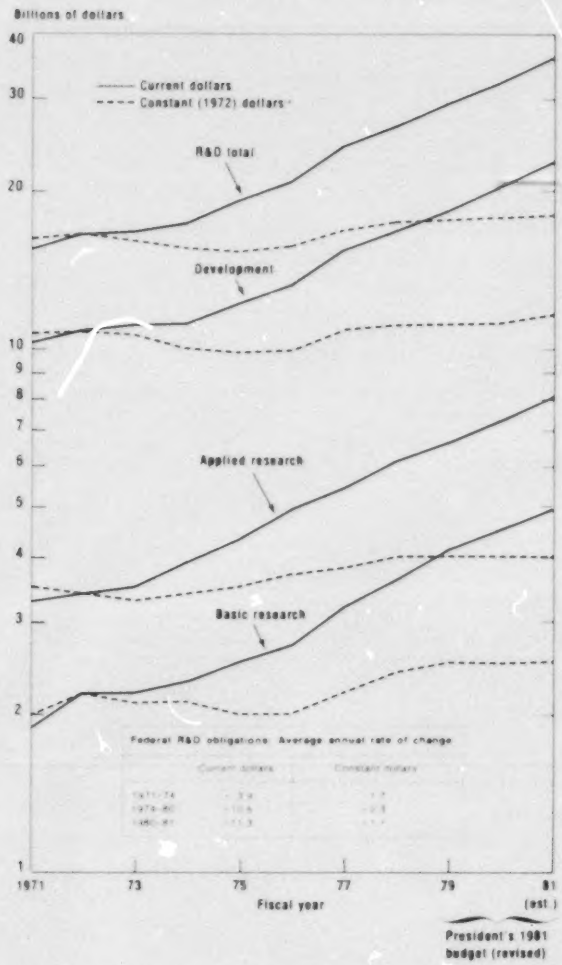
From 1971 until 1976, only in applied research did a small degree of real growth take place. In that period, the average annual rate of increase for applied research funding was 1.3 percent in constant dollars. For basic research the average annual decrease was less than 0.1 percent, and for development, 1.7 percent. From 1976 to 1981, however, these last two components—especially basic research—have shown the most rapid rates of growth. The average annual rate of growth for basic research in this recent period was 4.0 percent in constant dollars; for development, 2.8 percent; and for applied research, 1.8 percent. Despite the momentum of the last few years, the real level of development funding is still well below the 1967 high point, whereas basic research and applied research funding surpassed their former record levels in 1978.

Since the early sixties, the share of federally supported R&D activities within the national R&D total has declined steadily, while the share of industry-supported activities has grown. In 1964, the peak year, the Federal share was 66 percent, but by 1971 the ratio had fallen to 56 percent, and in 1981 it will have fallen to an estimated 48 percent. This trend developed even while Federal R&D funding in the late seventies showed real growth with impacts in all sectors, and with particular emphasis on research. As growth continues now, funding is more concentrated in the defense area with implications for growth in development programs and industrial performance.

[2] Federally funded research and development centers.

[3] Relatively uncontrollable outlays in the U.S. budget cover payments to individuals under social security, health insurance, veterans benefits, public assistance, and nutrition assistance, plus interest on the public debt, general revenue sharing, and other fixed cost and open-ended programs. Also included are carryover outlays from prior-year contracts and obligations that are excluded from open-ended programs and fixed costs. (See Office of Management and Budget, *The Budget of the United States Government, Fiscal Year 1981*, pp. 598–9, and *Fiscal Year 1981 Budget Revisions, March 1980* (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1980).) Such carryover outlays include R&D funds that NSF classifies within the relatively controllable portion of the budget. It should be noted that the ratio of R&D outlays to relatively controllable (or total) Federal outlays is calculated for purposes of analysis only and is not used in the budget decision process.

Chart 1. Trends in Federal R&D obligations (Semilog scale)



*Based on the GNP implicit price deflator for 1971–80 with an Office of Management and Budget (OMB) estimate of 10.1 percent for fiscal year 1981.
Source: National Science Foundation

Table 1. Federal obligations for research and development by character of work: fiscal years 1971–81

(Dollars in millions)

Fiscal year	Total	Research		Development
		Basic	Applied	
1971	$15,543	$1,946	$3,303	$10,294
1972	16,496	2,165	3,426	10,905
1973	16,800	2,193	3,454	11,154
1974	17,411	2,339	3,877	11,195
1975	19,039	2,536	4,305	12,198
1976	20,780	2,700	4,915	13,165
1977	23,984	3,191	5,413	15,380
1978	26,388	3,519	6,105	16,663
1979	28,978	4,097	6,576	18,305
1980 (est.)[1]	31,678	4,509	7,295	20,075
1981 (est.)[1]	35,492	4,902	8,006	22,584

[1]Data are based on the President's 1981 budget (revised).
Note: Detail may not add to totals because of rounding.
Source: National Science Foundation

Performers

The heavy emphasis on defense R&D support in the 1981 budget increased total R&D funding to a level that provides real growth in Federal R&D funds to three performing sectors: The Federal intramural sector, up an estimated 11 percent in 1981; the industrial sector (including FFRDC's), up an estimated 13 percent; and FFRDC's administered by other nonprofit institutions, up an estimated 14 percent (table 2). The strong growth shown by each of these sectors is attributable almost entirely to programs of DOD, the leading agency sponsor.

In the 1981 budget, the university-and-college sector received an 8-percent increase in R&D obligations—somewhat less than anticipated inflation. In this sector HHS is by far the leading support agency, and the small relative increase provided by that agency in 1981 tends to override an exceptionally high (19-percent) increase in DOD R&D support. The academic sector received sufficient Federal R&D support to reflect an annual average real growth of 7.2 percent in the 1976–79 period. This growth was interrupted in 1980, and a declining trend will develop in constant-dollar terms unless increases in basic research support proposed by the administration and later appropriations reverse this direction.

As in many years of the seventies, Federal intramural performance in the 1981 budget accounted for an estimated 25 percent of total Federal R&D obligations. Intramural performance includes not only direct R&D activities in Federal laboratories, but also the costs of administering those and extramural R&D activities. Among extramural performers, industry (including FFRDC's) continued to account for approximately 50 percent of the Federal R&D total. Universities and colleges accounted for 13 percent of the total, compared with 11 percent in 1971 (chart 2).

Table 2. Federal obligations for research and development by performer: fiscal years 1971 and 1979–81

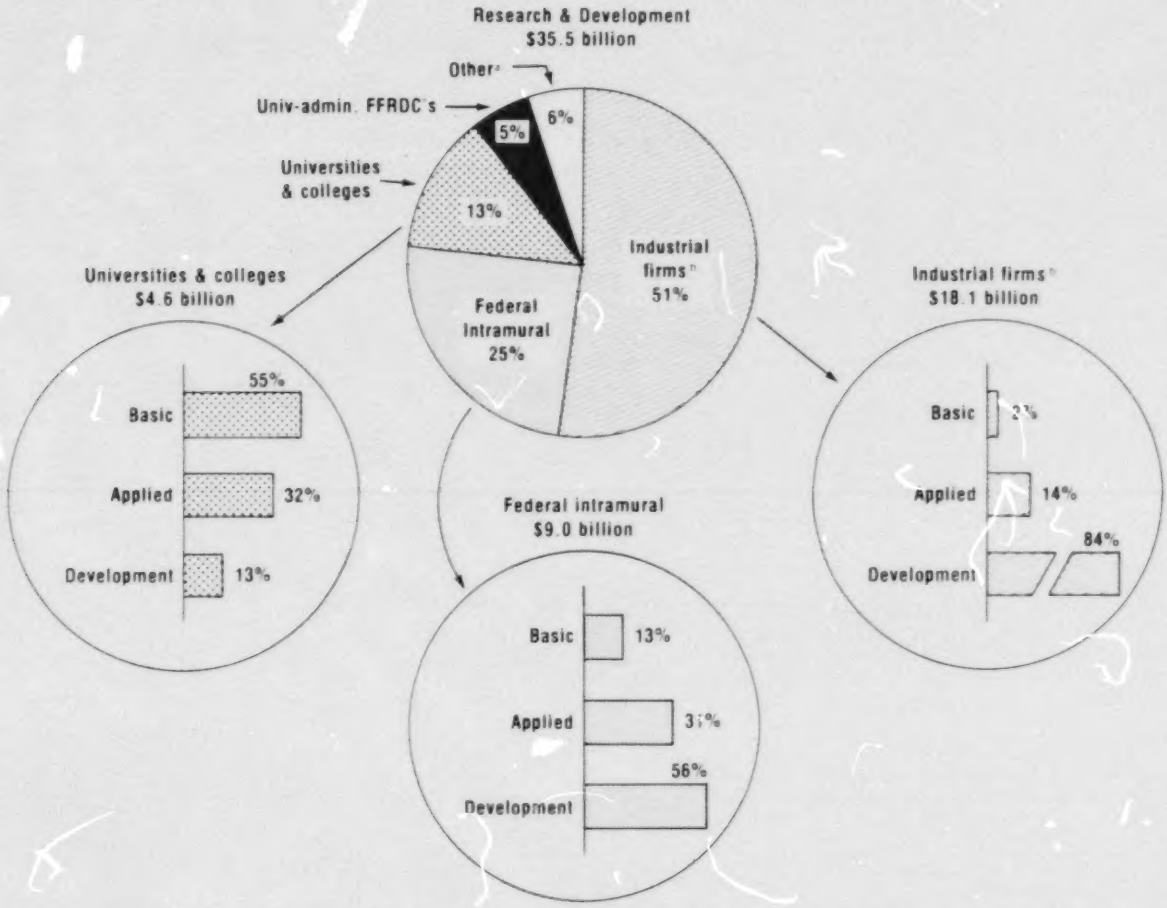
(Dollars in millions)

Performer	Actual			Estimated			
	1971	1979	Average annual percent change 1971–79	1980	Percent change 1979–80	1981	Percent change 1980–81
Total	$15,543	$28,978	+8.1	$31,878	+10.0	$35,492	+11.3
Federal intramural	4,205	7,497	+ 7.5	8,052	+ 7.4	8,965	+11.3
Industrial firms	7,608	12,900	+ 6.8	14,556	+12.8	16,642	+14.3
FFRDC's[1] administered by industrial firms	480	1,318	+13.7	1,389	+ 5.4	1,445	+ 4.0
Universities and colleges	544	3,886	+11.4	4,207	+ 8.2	4,556	+ 8.3
FFRDC's[1] administered by universities	729	1,511	+ 9.5	1,622	+ 7.3	1,734	+ 6.9
Other nonprofit institutions	463	1,031	+10.5	1,061	+ 2.9	1,085	+ 2.3
FFRDC's[1] administered by other nonprofit institutions	210	369	+ 7.3	418	+13.4	475	+13.5
State and local governments	141	310	+10.3	386	+24.4	407	+ 5.5
Foreign	63	155	+11.9	186	+20.1	183	- 1.5

[1] Federally funded research and development centers

Note: Data for 1979–81 are based on the President's revised 1981 budget.
Source: National Science Foundation

Chart 2. Federal obligations for research and development by performer and character of work: FY 1981 (est.)



[a] Includes other nonprofit institutions, FFRDC's administered by nonprofit institutions, State and local governments, and foreign performers.

[b] Includes federally funded research and development centers (FFRDC's) administered by this sector.

SOURCE: National Science Foundation

Fields of Science

The life sciences, the leading field in terms of Federal research funding since 1971, accounted for an estimated 35 percent of the Federal research total of $12.9 billion in the 1981 budget (chart 3). The average annual rate of growth between 1971 and 1980 was 11.3 percent, the highest of any major field, but the increase in the 1981 budget was only 6 percent. This increase reflects, chiefly, the small increase allotted to NIH biomedical research programs.

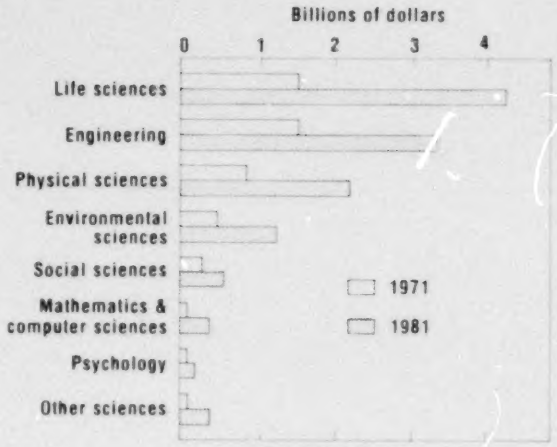
Engineering research funds, 25 percent of the Federal research total, grew at an average annual rate of only 7.3 percent in the 1971–80 period, but were 10 percent higher in the 1981 budget than in 1980. Nearly all of this gain resulted from an 18-percent increase in DOD programs. DOD contributes the largest share of research support to this field, followed by NASA, the Department of Energy (DOE), and the Nuclear Regulatory Commission (NRC).

The physical sciences made up 18 percent of all Federal research funding since 1971, accounted for registering average annual growth of 8.9 percent between 1971 and 1980. this field received a 14-percent gain in the 1981 budget, reflecting a policy of administration support in this area. DOE, DOD, and NSF increases contributed to an 18-percent overall growth in physics funding. The effect of this increase was moderated by the lesser increase (9 percent) in funding for chemistry, derived largely from programs of DOD, NSF, and the Environmental Protection Agency (EPA), and from the slight increase (6 percent) for astronomy, reflecting budget cutbacks for NASA, the lead agency.

The environmental sciences—atmospheric, geological, and oceanography—made up 10 percent of the Federal total in 1981. The broad field total grew at an average annual rate of 9.8 percent between 1971 and 1980, second only to the life sciences. The increase appearing in the 1981 budget, however, was 6 percent. A factor in this slowdown was the sharp cutback in basic research obligations in the March budget revision for NASA, the leading agency sponsor of environmental sciences research. The budget showed a 1-percent increase for atmospheric sciences, resulting mainly from a large reduction in NASA funds which the small increases in other agencies' programs did not offset. The geological sciences showed a 10-percent increase in 1981, and oceanography, funded principally by NSF and DOD, received only a 6-percent increase.

The social sciences, 5 percent of the Federal research total, showed the slowest growth of any field in the 1971–80 timespan—7.0 percent. The March budget contained a 7-percent increase for 1981. Social science research is chiefly supported by HHS, the Department of Agriculture (USDA), NSF, and the Department of Labor.

Chart 3. Federal obligations for research by field of science: FY 1971 and FY 1981 (est.)



SOURCE: National Science Foundation

Mathematics and computer sciences funding, 3 percent of the Federal research total, received a 25-percent increase in the 1981 budget—by far the largest relative increase of any field. During the 1971–80 period this area of science grew at an average annual rate of 9.3 percent. At present, DOD accounts for the largest support to this field, with NSF next. The 30-percent increase for DOD in 1981, mostly for computer sciences, cut across all major DOD subdivisions. The 16-percent increase for NSF was chiefly related to basic research support to both subfields.

Psychology, 2 percent of the 1981 Federal research total, showed a 12-percent increase in the 1981 budget. This compares with an average annual growth rate of 8.3 percent in the 1971–80 timespan. The largest support to research in psychology is provided by HHS, followed by DOD, the agency providing the chief impetus to growth in 1981.

1981 Program Changes

In the 1981 budget revision, a number of programs that had been scheduled for large increases were cut. Included among these were several initiatives that had been designed to meet needs in special areas, such as the industry/government cooperative program in automotive research, administered by

DOT; the industrial innovation program, under NSF and the Department of Commerce; and the NSF university research facilities program.

Several earlier initiatives were retained, namely, the competitive research grants program within USDA; the NSF industry university cooperative research program; and the interagency climate program, centered in the National Oceanic and Atmospheric Administration (NOAA) within Commerce. Among the six leading R&D support agencies, however, only DOD showed growth ahead of estimated inflation, whereas NSF funding levels just matched inflation (table 3).

DOD The 20-percent increase for DOD in 1981 amounted to 10-percent real growth. The share of DOD in the Federal R&D total was an estimated 47 percent in 1981, compared with 43 percent in 1980—an indication of the emphasis placed on defense in the 1981 budget.

The *Air Force* accounted for almost three-fourths of the proposed DOD increase in R&D support. The budget called for continued full-scale development of the strategic M-X missile system, which accounted for more than one-third of the Air Force total increase. The budget also projected substantial increases for a number of other programs, including the Air Force satellite communications system (AFSATCOM), the tactical satellite night attack program, the strategic space defense system, and the Air Force portion of the space shuttle program. The new tactical C-X long-distance cargo plane was to enter development in 1981. Some programs, such as the NAVSTAR global positioning system, were scheduled for declines as development reached later stages.

The *Army* accounted for most of the remaining increase contained in the budget for DOD R&D support, including a large increase in the tactical area for development of the division air-defense gun, and additional increases in the strategic area for the ballistic missile defense (BMD) advanced technology, and BMD systems technology programs. Funding for the advanced attack helicopter, the largest Army development program, was reduced in the 1981 budget.

Navy R&D support was scheduled to rise by only 2 percent in the 1981 budget, a decline in real terms. Increased support was provided for a number of individual programs, however, including the tactical Tomahawk cruise missile (SLCM) and advanced ASW torpedo programs, but the budget contained offsetting decreases in other tactical programs, such as the F/A-18 combat fighter (Hornet) and the LAMPS III helicopter.

Table 3. Federal R&D obligations by agency

(Dollars in millions)

Agency	Actual			Estimated			
	1971	1979	Average annual percent change 1971–79	1980	Percent change 1979–80	1981	Percent change 1980–81
Total	$15,543	$28,978	+ 8.1%	$31,878	+10.0%	$35,492	+11.3%
Department of Defense	7,509	12,506	+ 6.6	13,788	+10.2	16,604	+20.4
National Aeronautics and Space Administration	3,258	4,411	+ 3.9	5,114	+15.9	5,398	+ 5.6
Department of Energy	[1]303	4,639	+ 7.2	4,950	+ 6.7	4,995	+ .9
Department of Health and Human Services	[2]1,345	3,505	+12.7	3,777	+ 7.8	3,908	+ 3.5
National Science Foundation	337	808	+11.6	904	+11.9	995	+10.0
Department of Agriculture	305	663	+10.2	732	+10.4	778	+ 6.3
Environmental Protection Agency	137	410	+14.8	415	+ 1.1	445	+ 7.3
Department of the Interior	192	405	+ 9.8	426	+ 4.9	425	- .1
Department of Transportation	447	370	- 3.7	362	- 2.1	378	+ 4.5
Department of Commerce	144	309	+10.1	336	+ 9.4	373	+10.1
Nuclear Regulatory Commission	—	149	—	195	+32.0	218	+11.0
Department of Labor	23	137	+25.1	164	+19.7	193	+17.6
Department of Education	131	166	+ 3.0	153	- 7.9	164	+ 7.2
Veterans Administration	53	127	+ 9.2	131	+ 2.9	134	+ 2.2
International Development and Cooperation Agency	[3]30	106	+ 7.3	119	+11.7	[4]131	+10.5
Other agencies	270	266	- .2	309	+16.2	353	+14.2

[1] Atomic Energy Commission, including functions of the Nuclear Regulatory Commission.
[2] Department of Health, Education, and Welfare minus the Office of Education.
[3] Office of Education.
[4] Agency for International Development.
Note: Data for 1979–81 are based on the President's 1981 budget (revised).
Source: National Science Foundation.

Aside from development programs, the March budget retained an increase in DOD technology base programs (mostly research) of approximately 20 percent.

NASA The 1981 budget for NASA R&D programs included a rise of almost 6 percent in R&D support (or an overall real decrease). Althought space shuttle development within *space transportation systems* remained the largest single NASA program, making up almost 40 percent of the R&D total, support for this program was 1 percent below the 1981 level as development moved toward completion. Space flight operations activities in support of the shuttle were up 72 percent, accounting for almost all NASA R&D funding growth in the 1981 budget. Increases in this area were largely offset, however, by decreases in space sciences and space research and technology programs.

Space science programs received the largest cuts in the budget revisions, including postponement of the solar polar mission and decreased funding for Galileo development (the Jupiter orbiter and probe). The revised budget retained the gamma ray observatory, a new program, and continued support for development of the Earth-orbiting space telescope. The March budget revisions included a small increase for *space and terrestrial applications* programs; the largest single program was the Landsat-D resource observation satellite.

DOE Funding for the R&D portion of the 1981 DOE budget increased by less than 1 percent—a decline of approximately 9 percent in constant dollars. Within this total the programs related to civilian energy development and use fell below the 1980 level on an overall basis, while those related to atomic energy defense activities represented a 14-percent rise. The defense area accounted for one-fourth of the DOE R&D effort.

Nuclear fission, the largest DOE nondefense program area was reduced 22 percent in the 1981 budget, mostly reflecting a cutback in funds for the liquid metal fast breeder reactor (LMFBR) program, including plans to terminate the Clinch River demonstration project; other breeder programs were also reduced. The commercial waste management, spent nuclear fuel storage, and uranium enrichment programs were increased. *Fossil energy*, the second largest DOE civilian energy program, received a 12-percent reduction in the 1981 budget, mostly as a result of cuts in coal gasification and magnetohydrodynamics. The budget showed funds for *solar energy* programs up 15 percent over 1980, and *magnetic fusion* and *geothermal* development up 17 percent each. A 10-percent increase in the DOE *general science* program area was included, mostly representing growth in high-energy physics research.

Within the DOE *atomic energy defense* program, weapons R&D and testing activities comprised more than one-half the total. The budget increased funding for this program by 13 percent in 1981. Naval reactors development, the second largest support area, received only 4 percent more funds, but there were proposals for a 39-percent increase in inertial confinement fusion and a 29-percent increase for defense waste management programs.

HHS An increase of 4 percent was proposed in the HHS total for 1981, or a decrease in real terms. The National Institutes of Health (NIH) accounted for approximately 85 percent of all HHS R&D programs. NIH obligations, scheduled in the revised budget to increase only 3 percent in 1981, may receive a somewhat larger increase as a result of congressional appropriation actions.

In the March budget revision, the only institutes in the 1981 budget scheduled for increases that would almost meet or exceed inflation were the National Institute of Environmental Health Sciences (up 13 percent) and the National Institute of Arthritis, Metabolism, and Digestive Diseases (up 9 percent). The National Cancer Institute, which is the largest, showed virtually no change in the 1981 budget from the previous year, and the National Heart, Lung, and Blood Institute showed an increase of only 3 percent. These two institutes together accounted for 44 percent of the NIH total for 1981, compared with 51 percent in 1976.

An increase of 11 percent for the Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) would represent the second annual increment of funding to implement the recommendations of the President's Commission on Mental Health.

NSF The R&D programs of NSF received a 10-percent increase in the revised 1981 budget, compared with 17 percent in the original version. Real gains were shown in research support to mathematical and physical sciences, cross directorate, and ocean drilling programs. The gain in cross directorate activities resulted entirely from a doubling of the industry-university cooperative research program. The broad astronomical, atmospheric, earth, and ocean sciences program showed a 10-percent increase, with greatest growth in the astronomical sciences. The biological, behavioral, and social sciences program increased by 7 percent, as did the engineering and applied science (EAS) program. EAS originally showed a 21-percent increase, but the budget revisions eliminated the integrated basic

research program and reduced by one-half the small business innovation program.

USDA The budget included a 6-percent increase (or a real decrease) for USDA overall R&D programs in 1981. Agricultural Research programs, accounting for approximately one-half the USDA total, are concerned with animal production; plant production; soil, water, and air; processing, storage, and distribution; and human nutrition research. Although Agricultural Research decreased slightly, the human nutrition program reflected a 17-percent gain in the 1981 budget. Cooperative Research obligations increased only 5 percent, but within this broad area an increase of 56 percent was realized for the competitive research grants program. Forest Service R&D programs increased 11 percent in the 1981 proposal, with most of the increase related to trees, timber, and forest products management and utilization.

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Federal Funds for Research and Development, Fiscal Years 1979, 1980, and 1981, Volume XXIX will present the survey findings in further detail, relating them to broader indicators and current issues. The report will be obtainable from the Superintendent of Documents, U.S. Government Printing Office. The *Detailed Statistical Tables* (NSF 80-318) are obtainable on request from the National Science Foundation, Washington, D.C. 20550.

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